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OPTIMIZATION OF BATCH CHARGING IN THE GLASS FURNACE

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The problems of deterioration of the quality of the batch during storage and shipment are examined. Process solutions on optimizing batch and cullet charging in the glass furnace are examined.

One reserve in intensifying glass melting processes and conserving fuel and energy resources is to optimize batch charging in the glass furnace. For example, batch charging differentiated with respect to the charging pocket will allow stabilizing the distribution of the batch piles over the surface of the glass melt, reducing fuel consumption, and increasing the output of the glass furnace with a transverse flame direction [1].

Additional stabilization of the differentiated charging front, which has a horseshoe-shaped profile is ensured by the system for automatic control of the output of the batch chargers with the correction for the flame direction developed by V. V. Efremenkov (USSR Inventor's Certificate No. 1386596). This control system intensifies batch melting due to periodic movement of the batch charging maximum to the zone of maximum heat transfer of the flame tongue.

In the other existing system, the thermal and process regimes of the glass-melting process are controlled by the position of the boundary of the batch and the melting foam on the left and right of the longitudinal axis of the furnace and as a function of the sign and degree of asymmetry of the boundary, batch and cullet feed is redistributed on both sides of the furnace without altering the overall charge (USSR Inventor's Certificate No. 548575). Timely elimination of misalignments of the boundary of the batch and melting foam by redistribution of batch and cullet between chargers allows significantly increasing the chemical and temperature homogeneity of the glass melt by stabilizing production and convection flows.

The temperature and moisture content of the portions of batch and cullet loaded into the glass furnace significantly affect the batch melting conditions and temperature homogeneity of the glass melt. Decreasing the batch temperature causes it to cake during storage in the storage hoppers and decreasing the moisture content causes separation and dusting during shipment.

Similar problems of deterioration of batch quality also exist in glassworks whose batch-mixing sections are 100 – 300 m from the glass furnace, where the output in the batch-mixing sections is greater than 500 tons of batch a day with 2 – 8 batch storage hoppers. Since the batch is kept in the individual hoppers of these batch-mixing sections for 8 – 10 h, the quality of the batch can deteriorate significantly. To prevent this, it is necessary to optimize storage and unloading of the batch from the storage hoppers. In optimum unloading of the hoppers and feed of the batch to the mechanisms that move it to the batch charger hoppers into the glass furnace, the level of filling of the storage hoppers and batch storage time and temperature are taken into consideration (RF Patent No. 2040491).

The algorithm for optimum unloading of the batch storage hoppers was implemented for the first time by the developers of the automated batch preparation process introduced at Borsk Glassworks [2].

The storage hopper with the minimum temperature, maximum batch storage time, and minimum batch hopper filling level is automatically identified in the Manufacturing Process Automated Control System Encoder (MPACSE). Based on the selected priority parameter, the control system identifies one of the eight hoppers from which batch should be unloaded onto the conveyor. In transporting the batch with an operator-controlled electric car, a light panel with indication of the corresponding hopper selected for unloading is installed in the hopper unloading section. The control system similarly allows uniform successive unloading of the storage hoppers and prevents deterioration of the quality of the batch.

If the batch storage time is defined as a priority parameter that determines the order of unloading the hoppers, the temperature of individual portions of batch transported to the

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glass furnace can be decreased below the standard. A situation where the batch in the different hoppers has the same temperature with a different storage time can also arise. In both cases, the control system can predict deterioration of batch quality and correct the process of unloading and transporting the batch to the glass furnace.

When the temperature goes below 35°C, the batch becomes inhomogeneous [3]. Loading colder batch in the glass furnaces causes thermal inhomogeneity of the primary melt and greater fuel consumption for melting and homogenizing the glass melt in comparison to charging a freshly prepared batch.

We propose a method for controlling charging of raw materials in the glass furnace that takes into account the batch temperature and storage time in the storage bunkers (RF Patent No. 2172722). According to this method, the control system corrects the batch : cullet ratio toward an increase in consumption of cullet when there is a predicted decrease in bath quality. Fuel consumption remains unchanged.

One of the destabilizing factors that affect batch melting is the total moisture content of the mixture of batch and cullet loaded into the glass furnace. Although the decrease in the moisture content of the batch is basically correlated with the duration of preliminary storage of the prepared batch and the transport time to the glass furnace, fluctuations in the moisture content of the cullet are a function of the degree of its contamination, method of processing, storage conditions, and ratio of in-house and imported cullet. For example, the moisture content of in-house cullet in production of glass containers is a function of the ratio of wet and dry cullet entering the intermediate hoppers from the granulator and quality control lines. The moisture content of imported cullet is essentially a function of “dry” or “wet” processing schemes and the time of year. For this reason, creating a control system which executes advance control of the moisture content of in-house and imported cullet and corrects the process of moistening the melt in the mixer is of some interest.

It should be noted that most problems related to a decrease in the quality and optimization of batch and cullet feed into the glass furnace do not exist in construction of modern batch-mixing sections that only operate on conditioned raw material, with elimination of intermediate storage hoppers and reduction of batch and cullet transport lines.

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